

# **URBAN ELECTRIC VEHICLE (UEV) TECHNICAL SPECIFICATIONS**

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**Prepared by**  
Electric Transportation Applications

## MINIMUM VEHICLE REQUIREMENTS

The UEVAmerica Program is sponsored by the U.S. Department of Energy Office of Transportation Technology to provide for independent assessment of urban electric vehicles (UEV), designed specifically for use in an urban (surface street) environment with speeds no greater than 45 mph. These vehicles have full FMVSS certification but have limited speed maximum speeds. Vehicles tested under this program are evaluated against specific qualitative and quantitative metrics. The results provide potential users a method for comparing various UEVs against consistent standards and against each other, comparisons that might not otherwise be possible. The U.S. Department of Energy recognizes the UEVAmerica program as requisite for funding of programs involving UEVs.

For a vehicle to be considered qualified for testing under the UEV America Program, it must meet the minimum criteria defined by “shall” terminology utilized in the Specification. [For clarity, the use of the word “Shall” defines minimum requirements, whereas the use of the word “Should” defines design and performance objectives.] Vehicles that do not or cannot meet all of the “Shall” requirements will be considered Prototypes, and will not be considered as having successfully completed the Program. The following requirements must be met by any vehicle before it can receive consideration under the UEV America Program.

- (1) Vehicles shall comply with Federal Motor Vehicle Safety Standards applicable on the date of manufacture, and such compliance shall be certified by the manufacturer in accordance with 49 CFR 567. Suppliers shall provide a completed copy of Appendix B with their submittal, indicating the method of compliance with each section of 49 CFR 571. If certification includes exemption, the exemption number issued by the National Highway Transportation Safety Administration (NHTSA), the date of its publication in the Federal Register and the page number(s) of the Federal Register acknowledging issuance of the exemption shall be provided along with Appendix B. Only exemptions for non-applicable requirements shall be allowed.
- (2) Vehicles shall comply with the requirements of 49 CFR 571.105.S5.2.1, or alternatively, 49 CFR 571.105.S5.2.2 for parking mechanisms.
- (3) If the vehicle is equipped with fuel fired heaters, the vehicle shall comply with the requirements of 49 CFR 571.301.
- (4) The vehicles shall also comply with the requirement of FMVSS No. 305 as published in the Federal Register.
- (5) Suppliers shall provide the OEMs Gross Vehicle Weight Rating (GVWR). For Conversion vehicles, OEM GVWR shall not be increased.
- (6) Suppliers shall provide unloaded axle weights for the vehicle as delivered, and at full rated payload. For conversion vehicles, OEM Gross Vehicle Axle Weight Ratings (GAWR) shall not be increased.
- (7) For Conversion vehicles, the OEM passenger space shall not be intruded upon by the batteries, the battery box, or other conversion materials.
- (8) Suppliers shall provide information on their selected battery manufacturer’s recycling plan, including how it has been implemented
- (9) Vehicles shall have a minimum top speed of 45mph.

- (10) Vehicles shall have a minimum total vehicle payload of at least 400 pounds.
- (11) The vehicle shall be prevented from being driven with the key turned on and the drive selector in the drive or reverse position while the vehicle's charge cord is attached. Additionally, the following interlocks shall be present:
  - The controller shall not initially energize to move the vehicle with the gear selector in any position other than "PARK" or "NEUTRAL;"
  - The start key shall be removable only when the "ignition switch" is in the "Off" position, with the drive selector in "PARK;"
  - With a pre-existing non-idle accelerator input, the controller shall not energize or excite such that the vehicle can move under its own power from this condition.
- (12) When tested to the specifications of SAE J1718 APR97, concentrations of explosive gases shall not be allowed to exceed 25% of the LEL (Lower Explosive Limit) in the battery enclosure. Suppliers shall describe how battery boxes will be vented, to ensure any battery gases escape safely to atmosphere, during and following, normal or abnormal, charging and operation of the vehicle. Suppliers shall also meet the requirements of NEC 625 for charging in enclosed spaces without a vent fan.
- (13) The battery charger shall be capable of recharging the main propulsion battery to a state of full charge from any possible state of discharge in less than 12 hours, at temperatures noted in Section 5.6.
- (14) Chargers shall have the capability of accepting 120 or 208/240-volt single-phase 60-Hertz alternating current service, with a tolerance of  $\pm 10\%$  of rated voltage.
- (15) Chargers considered to be Level II or Level III shall have a true power factor of .95 or greater and a total harmonic distortion rated (THD) at  $\leq 20\%$  (current at rated load).
- (16) Charging circuits shall be isolated from the vehicle chassis such that ground current from the grounded chassis at any time while the vehicle is on charge or the charger is connected to an off-board power supply does not exceed 5 mA, in accordance with UL Standard 2202, June 1999.
- (17) Regardless of the charger type used, the charger shall be capable of meeting the requirements of Section 625 of the National Electric Code (NEC).
- (18) Vehicles shall not contain exposed conductors, terminals, contact blocks or devices of any type that create the potential for personnel to be exposed to 50 volts or greater (the distinction between low-voltage and high voltage, as specified in SAE J1127 JAN95, J1128 JAN95, et al.).
- (19) Propulsion power shall be isolated from the vehicle chassis such that battery leakage current is less than 0.5 MIU in accordance with UL Standard 2202, June 1999.
- (20) Replacement tires shall be commercially available to the end user in sufficient quantities to support the purchaser's needs.
- (21) All vehicles shall comply with the FCC requirements for unintentional emitted electromagnetic radiation, as identified in 47 CFR 15, Subpart B, "Unintentional Radiators."

- (22) Vehicles shall be equipped with an automatic disconnect for the main propulsion batteries. They shall also have a manual service disconnect. These disconnects shall be clearly labeled. [See Section 7.3]
- (23) All conductive or inductive type charging systems designed for use with the vehicle shall be in accordance with the Personnel Protection requirements of UL2202, June 1999.
- (24) Suppliers shall provide Material Safety Data Sheets (MSDS) for all batteries.

The following sections constitute the Technical Requirements of the Specification. Information has been categorized according to component and/or function. These sections provide an overview of the requirements and recommendations for Suppliers to use. This Technical Specification establishes the minimum requirements for Production level electric vehicles, as well as identifying design and performance objectives. Suppliers shall clearly describe the vehicle they are proposing by completing copies of Appendix A and Appendix B. Drawings should be provided showing the installation, location and layout of the conversion components, including the batteries, motor and controller, and powered accessories. The driveline should also be described, i.e., direct drive transmission, reduction gear ratio, etc. Suppliers should include any other information required to describe the vehicle.

No inference should be drawn by Suppliers or any other person that the measures listed in this specification are sufficient to make the vehicle safe, and each Supplier shall acknowledge **in writing** that 1) it is solely responsible for determining whether each vehicle offered for sale is safe, and 2) it is not relying on UEV America, Electric Vehicle Market Development Group (EVMDG), the Procurement Management Board (PMB), or any of the UEV America participants, their Consultants, or the U.S. Government as having, by this specification and its requirements, established minimally sufficient safety standards. This written statement shall be provided in the Supplier's proposal.

## **1.0 REGULATORY REQUIREMENTS**

### **1.1 FMVSS CERTIFICATION**

Vehicles shall comply with Federal Motor Vehicle Safety Standards applicable on the date of manufacture and such compliance shall be certified by the manufacturer in accordance with 49 CFR 567. If the vehicle is a converted vehicle, both the OEM, and Converter Manufacturer Certification labels, shall be visible per the requirements of 49 CFR 567. Suppliers shall provide a completed copy of Appendix B with their proposal, indicating the method of compliance with each required section of 49 CFR 571. If certification includes exemption, the exemption number issued by the National Highway Transportation Safety Administration (NHTSA), the date of its publication in the Federal Register and the page number(s) of the Federal Register acknowledging issuance of the exemption shall be provided along with Appendix B. Exemptions for any reason other than non-applicability shall not be allowed.

### **1.2 ZEV CERTIFICATION**

Vehicles should be certifiable under current California Air Resources Board (CARB) regulations as zero-emission vehicles. Further, the vehicle should conform to Environmental Protection Agency (EPA) requirements for receiving a ZEV Certificate of Conformity. If the vehicle is equipped with a fuel-fired heater, the heater should also meet this requirement. If the vehicle is certified as other than ZEV (e.g., ULEV), similar documentation should be provided.

### **1.3 SAFETY FEATURES**

Suppliers should describe safety measures and safety-related design features included in their vehicle design and provide an explanation of the purpose and anticipated effect on vehicle reliability and performance of any such safety measure or design feature.

### **1.4 MATERIAL SAFETY DATA SHEETS**

Suppliers shall supply Material Safety Data Sheets (MSDS) for all batteries the vehicle is equipped with, including auxiliary batteries.

### **1.5 BATTERY RECYCLING PLANS**

Suppliers shall provide information on their selected battery manufacturer's recycling plan including how it has been implemented. This plan should also identify post-purchase costs associated with recycling that will be passed on to the vehicle purchaser.

## **1.6 FEDERAL COMMUNICATIONS REQUIREMENTS**

All vehicles shall comply with the FCC requirements for unintentional emitted electromagnetic radiation, as identified in 47 CFR 15, Subpart B, “Unintentional Radiators”.

## **2.0 CHASSIS**

### **2.1 RATED PAYLOAD**

Vehicles shall have a minimum payload of 400 pounds.

### **2.2 CURB WEIGHT AND GROSS VEHICLE WEIGHT RATING (GVWR)**

For conversions, OEM GVWR shall not be increased. Suppliers should provide the curb weight, rated payloads and GVWR of their vehicles. For conversion vehicles, Suppliers shall specify the OEMs gross vehicle weight rating (GVWR).

### **2.3 VEHICLE WEIGHT DISTRIBUTION**

For conversions, OEM Gross Vehicle Axle Weight Ratings (GAWR) shall not be increased. Suppliers shall provide axle weights for the vehicle as delivered, and at full rated payload.

### **2.4 SPEEDOMETERS AND ODOMETERS**

Speedometers and odometers should be accurate to within a tolerance of less than 5% error.

### **2.5 BRAKING AND STEERING PERFORMANCE**

For conversions, braking and steering efforts should be similar to OEM models of comparable size and weight that are equipped with power brakes and power steering.

### **2.6 TIRES**

Tires shall be subject to the following requirements:

- Tires provided with the vehicle shall be the standard tire offered by the EV manufacturer for the vehicle being proposed.
- Tires shall correspond to the requirements of the placard installed in accordance with 49 CFR 571.109 and 110, or 119 and 120, as applicable.
- Suppliers shall specify manufacturer, model and size of the standard tire.
- Tires sizes and inflation pressures shall be in accordance with the requirements of the placard.
- At no time shall the tire's inflation pressure exceed the maximum pressure imprinted upon that tire's sidewall.
- The tire shall be operable across the entire operation/load range of that vehicle.
- Replacement tires shall be commercially available to the end user in sufficient quantities to support the purchaser's needs.
- Tires provided as original equipment by the EV manufacturer shall not have warranty restrictions in excess of those of the tire's manufacturer, unless the EV Manufacturer is the sole warrantor for the tires.

- If the vehicle may be equipped with more than one standard tire, this information shall be provided for each type/manufacturer of each standard tire.

Additionally, the tires should meet the following:

- The standard tire should be a low-rolling-resistance tire.

## **2.7 GROUND CLEARANCE**

Vehicles should have a ground clearance of at least five (5) inches to all sprung portions of the vehicle, with the vehicle loaded with rated payload (e.g. to GVWR).



### **3.0 VEHICLE CHARACTERISTICS**

#### **3.1 SEATING CAPACITY**

Seating capacity shall be a minimum of 1 driver. Suppliers shall specify seating capacity (available seat belt positions) for their vehicle. If the vehicle's seating capacity is changed from that specified by the OEM on the OEM FMVSS placard, the seat(s) being added or abandoned shall be modified as required by 49 CFR 571.207, et al, and a new FMVSS placard installed as required by 49 CFR 567, 568 or 571, as applicable.

#### **3.2 PASSENGER AND CARGO SPACE**

For conversion vehicles, the OEM passenger space shall not be intruded upon by the batteries, the battery box, or other conversion materials. Suppliers should specify interior passenger and cargo dimensions and volumes. All vehicles shall comply with the requirements of 49 CFR 571.305

#### **3.3 ELECTROMAGNETIC SUSCEPTIBILITY**

Vehicles should comply with the relevant sections of SAE J551 JUN94, "Test Limits and Methods of Measurement of Radio Disturbance Characteristics of Vehicles and Devices, Broadband and Narrowband, 150kHz to 1000MHz" for electromagnetic radiated fields. Vehicles should not be susceptible to externally generated electromagnetic radiation from an on-board transmitter (i.e., interaction will not render the vehicle un-safe or preclude operation of any systems required for safe operation of the vehicle).

Vehicles should be designed to minimize occupant exposure to electromagnetic fields generated by the propulsion system.

## **4.0 DRIVE SYSTEM**

### **4.1 TRANSMISSION**

The vehicle should utilize a single speed or multi-speed automatic transmission and a parking mechanism. Vehicle shall also be capable of reduced-speed reverse travel.

### **4.2 PARKING MECHANISM**

Vehicles shall comply with the requirements of 49 CFR 571.105.S5.2.1, or alternatively, 49 CFR 571.105.S5.2.2 for parking mechanisms.

### **4.3 REGENERATIVE BRAKING SYSTEM**

Regenerative braking should not adversely impact the vehicle's braking ability on varying road surfaces to such an extent that the vehicle's certification to 49 CFR571.105 or 49 CFR571.135(as applicable), et al, is impacted. Suppliers should describe the operation of the regenerative braking system and its' interface with braking and anti-lock brake systems.

### **4.4 OVERHEATING**

The vehicle motor and controller/inverter should be capable of continuous operation at maximum vehicle speed and/or sustained grades without overheating or loss of component life.

### **4.5 BATTERY VOLTAGE LIMITS**

The controller/inverter should limit the minimum traction battery discharge voltage to prevent degradation of battery life, and should limit the maximum regeneration voltage to prevent external gassing of the batteries. Suppliers should specify the voltage limits and describe how these limits are implemented.

### **4.6 DRIVE TRAIN**

Drive train components should not produce or develop unusual vibrations over the entire design speed range of the vehicle.

## **5.0 VEHICLE PERFORMANCE**

### **5.1 ACCELERATION**

The vehicle should have a 0-30 mph acceleration time of 8.5 seconds, or less, when operated with a payload of 332 pounds and starting with batteries at a 50% State of Charge.

### **5.2 MINIMUM TOP SPEED**

The vehicle shall have a minimum top speed of 45 mph within 1 mile, when operated with a payload of 332 pounds and starting with batteries at a 50% State of Charge.

### **5.3 LOW SPEED GRADEABILITY**

Vehicles should be capable of starting and ascending a 25% grade when operated with a payload of 332 pounds and starting with batteries at 50% State of Charge.

### **5.4 RANGE BETWEEN CHARGES**

Vehicles should have a range of at least 30 miles when operated with a payload of 332 pounds subjected to the UDS Drive Cycle (established in SAE J1634 MAY93) at an ambient temperature of  $77^{\circ}\text{F} \pm 9^{\circ}\text{F}$ .

### **5.5 TEMPERATURE DURABILITY**

Vehicles should be capable of standing for extended periods in extreme temperatures without damage to or failure of the vehicle or its systems. This includes ambient air temperatures of  $-20^{\circ}\text{F}$  to  $+120^{\circ}\text{F}$ , paved surface temperatures greater than  $150^{\circ}\text{F}$ , and occupant compartment temperatures exceeding  $170^{\circ}\text{F}$ .

### **5.6 WATER DURABILITY**

Vehicles should be able to drive through two (2) inches of standing water at a speed of 20 mph without damage, without becoming inoperable, and without battery to chassis leakage current exceeding 0.5 MIU per UL Standard 2202.

## **6.0 BATTERY**

### **6.1 BATTERY TYPE**

Suppliers should provide a detailed description of the main propulsion battery pack (including specific energy, specific power and discharge capacity to 80% DOD at the one-hour and three-hour rates), battery pack voltage, number of battery modules, and a summary of previous performance tests. Summary results of actual performance tests or computer simulations of the proposed battery in a similar vehicle should also be provided. If different, customer available and battery available DOD ratings should both be provided.

### **6.2 BATTERY CHARACTERISTICS**

Batteries shall comply with the requirements of SAE J1718 Apr97. For valve regulated batteries, the internal pressure level at which batteries vent should be specified. Suppliers should describe projected charge cycles at a specified level of discharge, how battery life is maximized, how end of life of each battery module and of the full battery pack is determined and how battery temperature gradients are minimized. Suppliers should specify maximum normal and abnormal gassing rates for the battery pack.

Propulsion batteries shall meet the requirements of NEC 625 and UL-2202 for charging in enclosed spaces without a vent fan. The vehicle shall be labeled as not requiring ventilation for charging (or have the appropriate classification label from a UL-recognized Testing Laboratory). Flooded, non-VRLA batteries are not permitted.

### **6.3 BATTERY PACK**

Suppliers should specify the weight of each battery module, and the weight of the battery pack (including removable pack structures). Suppliers should describe how batteries are installed in the vehicle (including details of module connection), the method of installation and removal of the batteries (and the battery box, if required) for maintenance and repair, the time required for battery removal and any special training, tools or equipment required for battery removal.

### **6.4 ELECTROLYTE CONTAINMENT**

Batteries and/or battery enclosures shall meet the requirements of SAE J1766 Feb96 and shall be designed and constructed in such a way that batteries and electrolyte will not intrude into the passenger compartment during or following FMVSS frontal barrier, rear moving barrier and side impact collisions, and roll-over requirements of 49 CFR 571.301. Vehicles shall also comply with the requirements of 49 CFR 571.305 "Electric-powered vehicles: electrolyte spillage and electrical shock prevention". Suppliers shall provide verification of conformance to these requirements.

## **6.5 BATTERY BOX**

Concentrations of explosive gases shall not be allowed to exceed 25% of the LEL (Lower Explosive Limit) in the battery box. Suppliers shall describe how battery boxes will be vented, to allow any battery gases to escape safely to atmosphere during and following normal or abnormal charging and operation of the vehicle. Suppliers shall provide a verification of conformance to SAE J1718 Apr97 on Battery Gas Emission.

Suppliers should describe the methods used to prevent or accommodate condensation in the battery box, and the quantity and maximum rate of explosive gas generation, by gas type, under normal and abnormal charging conditions.

## **6.6 PARALLEL BATTERY PACKS**

Suppliers should not provide vehicles with parallel battery packs. If a Supplier provides a vehicle with parallel battery packs, the Supplier should provide detailed information on the equipment and charging algorithms required to prevent the parallel strings from becoming unbalanced.

## **6.7 BATTERY MAINTENANCE**

Maintenance requirements for the propulsion batteries should be described and any associated cost(s) to the consumer/end user should be clearly defined.

## **6.8 BATTERY CHARGING ALGORITHM**

Suppliers should verify that the method(s) of charging the propulsion batteries and the charging algorithm(s) do not impact the battery supplier's warranty available to end-user. The charging algorithm(s) should have been reviewed and approved by the battery manufacturer.

## **6.9 BATTERY MANAGEMENT SYSTEM**

The vehicle should be equipped with a Battery Management System (BMS). This system should monitor propulsion battery pack and module voltages, temperatures and state of charge. Further, the BMS should automatically limit battery discharge below a pre-determined minimum level. If a BMS is provided, the manufacturer shall provide a description of the BMS' operation. This description shall be consistent with that provided in the owner's manual.

The charger system should include equipment to maintain each module in the battery pack at equal temperature and within the allowed temperature range of the battery throughout each charge-discharge cycle.

## **7.0 ELECTRICAL**

### **7.1 ELECTRICAL SAFETY**

Vehicles shall not contain exposed conductors, terminals, contact blocks or devices of any type that create the potential for personnel to be exposed to 50 volts or greater (the distinction between low-voltage and high voltage, as specified in SAE J1127, J1128, et al.). Access to any high voltage components shall require the removal of at least one bolt, screw, or latch. Devices considered to be high voltage components shall be clearly marked as HIGH VOLTAGE. These markings should be installed at any point the voltage can be accessed by the end user. Additionally, cable and wire marking shall consist of orange wire and/or orange sleeving as identified in SAE-J1127 MAR88.

### **7.2 ELECTRICAL ISOLATION**

Propulsion power shall be isolated from the vehicle chassis such that leakage current does not exceed 0.5 MIU as identified in UL-2202. Charging circuits shall be isolated from the vehicle chassis such that ground current from the grounded chassis does not exceed 5 mA at any time the vehicle is connected to an off-board power supply. Suppliers should provide details on grounding and isolation methods.

Furthermore, for impact conditions, the vehicles shall also comply with the requirement of proposed 49 CFR 571.305 "Electric-powered vehicles: electrolyte spillage and electrical shock prevention" Suppliers shall provide verification of conformance to these requirements.

### **7.3 BATTERY DISCONNECT**

Vehicles shall be equipped with an automatic disconnect for the main propulsion batteries. The disconnect shall operate to isolate the propulsion circuits any time the chassis becomes energized from contact with the propulsion battery or its associated circuits. This disconnect shall be capable of interrupting maximum rated controller/inverter current. The Supplier shall describe the automatic disconnect provided for the main propulsion batteries.

A manual service disconnect shall also be required. A decal or other label denoting the location of the device should be affixed to the driver's sun visor. A similar decal should be affixed to the inside of the vehicle such that it is visible to individuals located outside the vehicle through the lower left-hand corner of the rear window. Visibility and labeling requirements should be the same as those denoted in 49 CFR 565 for VIN labels. This disconnect should be operable from the driver's seated position. It shall have the following capabilities:

- Have Manual action to break the connection
- The disconnection is physically verifiable
- The disconnection does not create exposed conductors capable of becoming energized while exposed.

Alternately, the key-switch may be used to satisfy the operability portion of the manual service disconnect requirement, if it interrupts all control power going to the controller and the main battery contactor(s). The manual service disconnect is not required to operate under load.

#### **7.4 SAFETY INTERLOCK SYSTEM**

The vehicle shall be prevented from being driven with the key turned on and the drive selector in the drive or reverse position while the vehicle's charge cord is attached. Additionally, the following interlocks shall be present:

- The controller shall not initially energize to move the vehicle with the gear selector in any position other than "PARK" or "NEUTRAL;"
- The start key shall be removable only when the "ignition switch" is in the "Off" position, with the drive selector in "PARK;"
- With a pre-existing non-idle accelerator input, the controller shall not energize or excite such that the vehicle can move under its own power from this condition.

#### **7.5 OPERATION OF HAZARD LIGHTS**

Hazard lights should be capable of at least one hour of continuous operation in the event of shutdown or isolation of the main battery pack or failure of the DC/DC converter system as described in SAE J590b.

#### **7.6 STATE OF CHARGE INDICATOR**

The vehicle should include a state of charge indicator for the main propulsion battery. Indications should be accurate to within 5% of full scale throughout its useable range.

#### **7.7 CONNECTORS**

High voltage plugs, receptacles, couplers should meet the proposed requirements of UL2251-1. Low voltage connectors should meet the requirements of applicable SAE Standards, including J163, J561, J858, et al. High voltage connectors should utilize locking devices, should be keyed to prevent misconnection, and should be moisture proof.

## **8.0 CHARGER SYSTEM**

### **8.1 CHARGER OPERATION**

Vehicles shall be equipped with a battery charger and capable of recharging the main propulsion battery to a state of full charge from any possible state of discharge in less than twelve (12) hours at temperatures noted in Section 5.5. The preferred recharge time should be less than eight (8) hours.

The charger should maintain each battery module at a consistent state of charge over the life cycle of the battery. The charger should not charge the batteries in a manner that would cause venting of gas or liquid. The charger should be fully automatic, determining when “end of charge” conditions are met and transitioning into a mode that maintains the main propulsion battery at a full state of charge while not overcharging it, if continuously left on charge. The charger should also minimize the energy required to maintain the main propulsion battery in a fully charged state, particularly during extended periods on charge.

### **8.2 CHARGING INPUT POWER**

Chargers shall have the capability of accepting input voltages of 120 or 208/240 volts single-phase 60-Hertz alternating current service, with a tolerance of  $\pm 10\%$  of rated voltage. On-board personnel protection systems, which may include ground fault circuit interrupters (GFCI), shall be in accordance with the provisions of UL Standard 2202.

### **8.3 POWER QUALITY**

Chargers shall have a true power factor of .95 or greater and a total harmonic distortion (THD) of the current of less than 20%, when operating at full rated load.

### **8.4 VEHICLE CHARGER CONNECTIONS**

Suppliers should describe the type, size and location of the point of the vehicle charging port. The charge connector should comply with the requirements of SAE J1772 or SAE J1773, as appropriate. Regardless of the charger type used, the charger shall conform to the requirements of UL Standard 2202, June 1999.



## **9.0 OPTIONS**

Suppliers should describe the following options, which are to be priced separately from the base vehicle. The installation of options does not relieve Suppliers of meeting other “shall” requirements. Suppliers should specify the impact on range and payload for each option. Suppliers are encouraged to include pricing and technical information on the following options.

### **9.1 AIR CONDITIONING SYSTEM**

If the vehicle can be equipped with an air conditioner, suppliers should describe the design of the air conditioning system and verify that it uses no chloroflourocarbons (CFCs).

### **9.2 OCCUPANT COMPARTMENT PRE-HEATING & COOLING SYSTEM**

Suppliers should briefly describe the design of a pre-heating and pre-cooling system that allows passenger compartment temperatures to be maintained while the vehicle is on charge.

### **9.3 RANGE EXTENSION OPTIONS**

Suppliers should describe options that increase the vehicle’s range between recharges. Such options may include, but should not be limited to, advanced batteries and more efficient drive systems.

### **9.4 COLD WEATHER RANGE EXTENSION**

Suppliers should describe the design of a system that will ensure a vehicle range of at least 30 miles when subjected to the UDS Drive Cycle contained in SAE J1634 May93 with the vehicle operated in an outdoor ambient temperature that does not exceed 25°F after the vehicle has been parked for 48 hours at ambient 10°F with the vehicle plugged in. This system should operate concurrent with the charging system, and should not require the use of additional connection points. It should not require manual intervention, and should operate at all input voltages for which the charger is rated.

### **9.5 PASSENGER COMPARTMENT HEATER**

Suppliers should describe the design feature(s) that ensure the vehicle heating system is capable of maintaining interior temperatures of at least 65°F at an ambient temperature of 10°F. If fuel fired heaters are used, they shall meet the requirements of Section 1.2. Further, heater fuel containments shall meet the requirements of 49 CFR 571.301.

### **9.6 CONTROLLER/INVERTER MEASUREMENT SYSTEM**

Suppliers should describe a diagnostic system for the controller/inverter.

### **9.7 120V CHARGER**

Suppliers should make available a 120V charger, either as permanent installation or as a portable carry-on. This charger shall comply with the requirements of Section 7.2 for isolation and Section 8.2 for personnel protection. The charger should recharge the vehicle as quickly as possible from a 15A single phase GFCI-breaker.

### **9.8 AMMETER**

Suppliers should offer an ammeter or similar indicator capable of providing an indication of the charging and discharging currents of the propulsion battery.

### **9.9 BATTERY VOLTAGE INDICATOR**

The vehicle should include a battery system voltage indicator.

### **9.10 AMP-HOUR INDICATOR**

The vehicle should include at least one of the following devices:

- An amp-hour indicator which integrates on both charge and discharge
- A kilowatt meter capable of measuring power out of the main propulsion batteries

If an ammeter or kilowatt meter is used, it should also provide measurement of current or power.

### **9.11 OTHER OPTIONS**

Vehicle manufacturers should provide a list of all options that are available with the vehicle.

## **10.0 DOCUMENTATION**

### **10.1 SERVICE MANUALS**

Vehicles should be accompanied by non-proprietary manuals for parts, service, operation and maintenance, interconnection wiring diagrams and schematics, (with pricing for optional manuals). Included should be details on the design and operation of vehicle systems, as well as prices and availability of parts and service and a list of additional or special maintenance tools required.

### **10.2 TRAINING PROGRAM**

Suppliers should offer a training program for the purchaser's maintenance personnel covering vehicle safety and proper operation and maintenance of vehicles. Costs of this program should be included in the base price of the vehicle.

## APPENDIX A

### PERFORMANCE

Time required to accelerate from 0-45 mph on a level grade \_\_\_\_\_  
Time required to accelerate from 0-45 mph on a 3% grade \_\_\_\_\_  
Time required to accelerate from 0-35 mph on a 6% grade \_\_\_\_\_  
Maximum speed attainable on a level grade \_\_\_\_\_  
Maximum grade attainable from a standing start at GVWR \_\_\_\_\_  
Range at a constant speed of 35 mph \_\_\_\_\_  
Range over the SAE J1634 UDS cycle \_\_\_\_\_

### BATTERY CHARACTERISTICS (referenced to 77°F)

Manufacturer \_\_\_\_\_  
Model \_\_\_\_\_  
Type \_\_\_\_\_  
Description \_\_\_\_\_  
Number of Batteries in the Pack \_\_\_\_\_  
Arrangement (series or parallel) \_\_\_\_\_  
Battery module voltage \_\_\_\_\_  
Battery pack voltage \_\_\_\_\_  
Battery module weight \_\_\_\_\_  
Battery pack weight \_\_\_\_\_  
Maximum Normal Gassing Rate (scfm or cc/ml/m) \_\_\_\_\_  
Maximum Abnormal Gassing Rate (scfm or cc/ml/m) \_\_\_\_\_  
Battery amp-hour capacity to 100% Manufacturer's DOD, 1 hour rating \_\_\_\_\_  
Battery amp-hour capacity to 100% Manufacturer's DOD, 2 hour rating \_\_\_\_\_  
Battery amp-hour capacity to 100% Manufacturer's DOD, 3 hour rating \_\_\_\_\_  
Battery watt-hour capacity to 100% Manufacturer's DOD, 1 hour rating \_\_\_\_\_  
Battery watt-hour capacity to 100% Manufacturer's DOD, 2 hour rating \_\_\_\_\_  
Battery watt-hour capacity to 100% Manufacturer's DOD, 3 hour rating \_\_\_\_\_  
Probable life of an average battery (number of cycles) to a Manufacturer's DOD of:  
    To 50% \_\_\_\_\_  
    To 80% \_\_\_\_\_  
Price of Replacement Batteries, per battery module (\$) \_\_\_\_\_  
Price of Replacement for entire battery pack (\$) \_\_\_\_\_  
Time Required to Recharge the batteries at 208V from a Customer's DOD of:  
    From 50% \_\_\_\_\_  
    From 80% \_\_\_\_\_  
Time Required to Recharge the batteries at 120V from a Customer's DOD of:  
    From 50% \_\_\_\_\_  
    From 80% \_\_\_\_\_

## APPENDIX A (cont)

### CHARGER CHARACTERISTICS

Manufacturer \_\_\_\_\_  
Model \_\_\_\_\_  
Description \_\_\_\_\_  
Location \_\_\_\_\_  
Charger Efficiency \_\_\_\_\_  
Charger Input Voltages \_\_\_\_\_  
Maximum Charger Current Output \_\_\_\_\_

### MOTOR CHARACTERISTICS

Manufacturer \_\_\_\_\_  
Model \_\_\_\_\_  
Description \_\_\_\_\_  
Type and Phase (AC, DC, Brushless, etc.) \_\_\_\_\_  
kW Rating at Voltage and Current \_\_\_\_\_  
Rated Efficiency at kW Output \_\_\_\_\_  
Operating Range (RPM) \_\_\_\_\_  
Maximum Continuous Current \_\_\_\_\_  
Operating Temperature Range (°F) \_\_\_\_\_  
Cooling Medium and Method \_\_\_\_\_

### CONTROLLER CHARACTERISTICS

Manufacturer \_\_\_\_\_  
Model \_\_\_\_\_  
Description \_\_\_\_\_  
Type and Phase \_\_\_\_\_  
Input Voltage Range \_\_\_\_\_  
Maximum Output Amps \_\_\_\_\_  
Type of Power Electronics (SCR, mosfet, etc.) \_\_\_\_\_  
Rated Efficiency (at current) \_\_\_\_\_

### TRANSMISSION CHARACTERISTICS

Manufacturer \_\_\_\_\_  
Type \_\_\_\_\_  
Model \_\_\_\_\_  
Description (Single Speed Manual, Automatic, Other) \_\_\_\_\_  
Gear Ratio(s) \_\_\_\_\_  
Estimated Efficiency Losses (including support systems) \_\_\_\_\_

**CHASSIS CHARACTERISTICS - Pre-Conversion**

Make, Year and Model (pre-conversion) \_\_\_\_\_  
Gross Vehicle Weight Rating (GVWR) \_\_\_\_\_  
Gross Axle Weight Rating (Front) \_\_\_\_\_  
Gross Axle Weight Rating (Rear) \_\_\_\_\_  
Curb Weight (as designed) \_\_\_\_\_  
Weight Distribution (as designed) \_\_\_\_\_  
Payload Capacity (as designed) \_\_\_\_\_  
Ground Clearance from Lowest Point on Chassis at GVWR \_\_\_\_\_  
Drive Wheels (F/R) \_\_\_\_\_

**CHASSIS CHARACTERISTICS - Post-Conversion or UEV OEM**

Make, Year and Model \_\_\_\_\_  
Gross Vehicle Weight Rating (GVWR) \_\_\_\_\_  
Gross Axle Weight Rating (Front) \_\_\_\_\_  
Gross Axle Weight Rating (Rear) \_\_\_\_\_  
Curb Weight (as designed) \_\_\_\_\_  
Weight Distribution (as designed) \_\_\_\_\_  
Payload Capacity (as designed) \_\_\_\_\_  
Ground Clearance from Lowest Point on Chassis at GVWR \_\_\_\_\_  
Drive Wheels (F/R) \_\_\_\_\_

**BRAKING**

Type Front \_\_\_\_\_  
Type Rear \_\_\_\_\_  
Source of Vacuum (if used) \_\_\_\_\_  
Average Power Required (watts) \_\_\_\_\_  
Regenerative Braking \_\_\_\_\_

**TIRES**

Manufacturer \_\_\_\_\_  
Model \_\_\_\_\_  
Description \_\_\_\_\_  
Size and Profile \_\_\_\_\_  
Rolling Resistance Rating \_\_\_\_\_  
Pressure, Front and Rear \_\_\_\_\_  
Tire Payload Capacity \_\_\_\_\_  
Warranted Tire Life \_\_\_\_\_

### **SUSPENSION**

Type Front \_\_\_\_\_

Type Rear \_\_\_\_\_

Modifications Made During Conversion \_\_\_\_\_

### **STEERING**

Type \_\_\_\_\_

Description \_\_\_\_\_

Manufacturer \_\_\_\_\_

Average Power Required (watts) \_\_\_\_\_

### **AIR CONDITIONING**

Manufacturer \_\_\_\_\_

Model \_\_\_\_\_

Description \_\_\_\_\_

Compressor Type \_\_\_\_\_

Compressor Output (BTUs per hour) \_\_\_\_\_

Motor Type \_\_\_\_\_

Motor Electrical Rating \_\_\_\_\_

Average Power Required (watts) \_\_\_\_\_

### **HEATING SYSTEMS**

Manufacturer \_\_\_\_\_

Model \_\_\_\_\_

Description \_\_\_\_\_

Type \_\_\_\_\_

Output (BTUs per hour) \_\_\_\_\_

Average Power Required (watts) \_\_\_\_\_

## **METHOD OF ACHIEVING**

### **COMPLIANCE**

#### **49 CFR 571.100 SERIES**

##### **OEM Certified**

##### **Vehicle Test**

##### **Analysis Only**

##### **Not Certified**

##### **Not Required**

- 101 - Controls and Displays
- 102 - Transmission Shift Lever Sequence, Starter Interlock & Transmission Braking Effect
- 103 - Windshield Defrosting and Defogging Systems
- 104 - Windshield Wiping and Washing Systems
- 105 - Hydraulic Brake Systems
- 106 - Brake Hoses
- 108 - Lamps, Reflective devices, and Associated Equipment
- 109 - New Pneumatic Tires
- 110 - Tire Selection and Rims
- 111 - Rearview Mirrors
- 113 - Hood Latch System
- 114 - Theft Protection
- 116 - Motor Vehicle Brake Fluids
- 117 - Retreaded Pneumatic Tires
- 118 - Power Operated Window, Partition, and Roof Panel Systems
- 119 - New Pneumatic Tires for Vehicles Other Than Passenger Cars
- 120 - Tire Selection and Rims for Motor Vehicles Other Than Passenger Cars
- 121 - Air Brake Systems
- 124 - Accelerator Control Systems
- 125 - Warning Devices
- 129 - New Non-Pneumatic Tires for Passenger Cars
- 135 - Passenger Car Brake Systems

## **METHOD OF ACHIEVING**

### **COMPLIANCE**

#### **49 CFR 571.200 SERIES**



## **OEM Certified**

### **Vehicle Test**

### **Analysis Only**

### **Not Certified**

### **Not Required**

- 201 - Occupant Protection in Interior Impact
- 202 - Head Restraints
- 203 - Impact Protection for the Driver from the Steering Control System
- 204 - Steering Control Rearward Displacement
- 205 - Glazing Materials
- 206 - Door Locks and Door Retention Components
- 207 - Seating Systems
- 208 - Occupant Crash Protection
- 209 - Seat Belt Assemblies
- 210 - Seat Belt Assembly Anchorages
- 212 - Windshield Mounting
- 213 - Child Restraint Systems
- 214 - Side Impact Protection
- 216 - Roof Crush Resistance - Passenger Cars
- 219 - Windshield Zone Intrusion
- 225 - Child Restraint Anchorage Systems

### **49 CFR 571.300 SERIES**

- 301 - Fuel System Integrity
- 302 - Flammability of Interior Materials
- 305 - EV: Electrolyte Spillage and Shock Protection

### **49 CFR 565 SECTION AND TITLE**

Vehicle Identification Number Requirements - All Sections

### **49 CFR 581 SECTION AND TITLE**

Bumper Standard Requirements - All Sections

## APPENDIX B

	METHOD OF ACHIEVING COMPLIANCE				
	OEM Certified (Conversion)	Vehicle Test	Analysis Only	Not Certified	Not Required
<b>49 CFR 571.100 SERIES</b>					
101 - Controls and Displays					
102 - Transmission Shift Lever Sequence, Starter Interlock & Transmission Braking Effect					
103 - Windshield Defrosting and Defogging Systems					
104 - Windshield Wiping and Washing Systems					
105 - Hydraulic Brake Systems					
106 - Brake Hoses					
107 - Reflecting Surfaces					
108 - Lamps, Reflective devices, and Associated Equipment					
109 - New Pneumatic Tires					
110 - Tire Selection and Rims					
111 - Rearview Mirrors					
113 - Hood Latch System					
114 - Theft Protection					
116 - Motor Vehicle Brake Fluids					
117 - Retreaded Pneumatic Tires					
118 - Power Operated Window, Partition, and Roof Panel Systems					
119 - New Pneumatic Tires for Vehicles Other Than Passenger Cars					
120 - Tire Selection and Rims for Motor Vehicles Other Than Passenger Cars					
121 - Air Brake Systems					
124 - Accelerator Control Systems					
125 - Warning Devices					
129 - New Non-Pneumatic Tires for Passenger Cars					
135 - Passenger Car Brake Systems					

## APPENDIX B

	METHOD OF ACHIEVING COMPLIANCE				
	OEM Certified (Conversion)	Vehicle Test	Analysis Only	Not Certified	Not Required
<b>49 CFR 571.200 SERIES</b>					
201 - Occupant Protection in Interior Impact					
202 - Head Restraints					
203 - Impact Protection for the Driver from the Steering Control System					
204 - Steering Control Rearward Displacement					
205 - Glazing Materials					
206 - Door Locks and Door Retention Components					
207 - Seating Systems					
208 - Occupant Crash Protection					
209 - Seat Belt Assemblies					
210 - Seat Belt Assembly Anchorages					
212 - Windshield Mounting					
213 - Child Restraint Systems					
214 - Side Impact Protection					
216 - Roof Crush Resistance - Passenger Cars					
219 - Windshield Zone Intrusion					
225 - Child Restraint Anchorage Systems					
<b>49 CFR 571.300 SERIES</b>					
301 - Fuel System Integrity					
302 - Flammability of Interior Materials					
305 - EV Electrolyte Spillage and Shock Protection					
<b>49 CFR 581 SECTION AND TITLE</b>					
Bumper Standard Requirements - All Sections					
<b>49 CFR 565 SECTION AND TITLE</b>					
Vehicle Identification Number Requirements					